

**REMARKS/ARGUMENTS**

Re-examination and favorable reconsideration in light of the following comments are respectfully requested.

Claims 1 - 24 are pending in the application. Currently, claims 1 - 15 and 17 - 24 stand rejected and claim 16 stands allowed.

New claim 45 has been added to the application.

In the office action mailed June 29, 2004, claims 1, 2, 4 - 14, and 17 - 24 were rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,388,959 to Forrester et al. in view of EPO Patent Publication No. 939143 to Scheckenbach; and claims 3 and 15 were rejected under 35 U.S.C. 103(a) as being unpatentable over Forrester et al. in view of Scheckenbach and further in view of U.S. Patent No. 3,834,001 to Carroll et al.

The foregoing rejections are traversed by the present response.

With respect to the rejection of claims 1, 2, 4 - 14, and 17 - 24 on obviousness grounds over Forrester et al. and Scheckenbach, the Forrester et al. patent relied upon by the Examiner relates to a fan assembly (5) for a gas turbine engine having a stator casing (10) made of a first material and an annular abradable seal structure (22) made of a second material. The seal structure (22) has an abradable inner annular surface (24) against which is juxtaposed tips (26) of fan blades (28) of rotor (10). As shown in FIG. 3 of the Forrester et al. patent, the second material comprises a sheet (42) of epoxy foam including chopped fiberglass reinforcing fibers and microballoons. The sheet (42) is directly bonded to the inner annular surface (41) of the inner annular grooves (20) of the casing (10). The sheet (42) serves as an abradable seal

structure and provides abradable seal surface (24). The composition of the sheet (42) is selected to have a coefficient of thermal expansion which is moderately greater than the metal of the casing. The fiberglass fibers are randomly disposed and oriented to provide internal structural support to the sheet.

As stated by Forrester et al. at column 3, line 14 et seq., "[d]uring cure, epoxy foam material (42) expands to fill and conform to the shape of the groove (20). It is cured and self-bonded to the groove (20) at 30 psi and 250 degrees F for two hours. The epoxy foam material (42) has a density of 25 pounds per cubic foot."

Claim 1 in the instant application calls for the abradable seal layer to be composed of a densified polyimide foam. Forester et al does not teach or suggest forming the abradable seal layer from such a material. Recognizing this deficiency, the Examiner cites the Scheckenbach et al. patent document.

A review of Scheckenbach shows that this patent document relates to a material used for thermal spraying made from, or preferably incorporating a particular high temperature polymer, and to a process of forming a coating from such material by thermal spraying. The thermal spraying technique used by Scheckenbach relates to the spraying of a powdered material. The invention in Scheckenbach provides a thermal spray powder comprising from 1 to 99% by weight of oxidized polyarylene sulfide and from 1 to 99% by weight of a metal powder. Scheckenbach goes on to say that improvements in resistance to thermal cycling can be achieved by the addition of a second component by addition of metals, carbides, ceramics, and other high temperature polymers like polyimides, polyamide imides, polyester imides or aromatic polyester plastics, or mixtures thereof with a preferred additional being metal. Scheckenbach

goes on to say that the coatings produced with a polymer/metal mixture (emphasis added) may be used in the compressor section of gas turbine engines. Scheckenbach also goes on to say that properties of the coatings can under certain circumstances be further modified by a heat treatment to densify the coating.

Despite the foregoing, Scheckenbach never teaches or suggests an abradable seal layer composed of a densified polyimide foam. In fact, what Scheckenbach teaches is using a thermally sprayed polymer/metal mixture as a coating for a turbine engine component. It is submitted that the Examiner has misread the Scheckenbach reference and as a result has misapplied the reference. With regard to the combination of references, one of ordinary skill in the art would not combine them in the manner suggested by the Examiner because Scheckenbach does not teach or suggest how to form a densified epoxy foam composing a polyimide material. Further, there is nothing in Scheckenbach would teach or suggest to one of ordinary skill in the art that when providing an abradable seal layer for a turbine engine component that one wants to select a polyimide material from the list of candidates. In fact, Scheckenbach teaches away from it, by saying that the coating for an engine component should be a polymer/metal mixture. For this reason, claim 1 is allowable over the cited and applied references.

Claim 2 is allowable because neither of the cited and applied references teach an abradable seal layer having at least one layer of the densified polyimide foam.

Claims 4 and 19 are allowable because neither of the references teaches the use of a polyimide foam having a density of at least 10 pounds per cubic foot. As for the Examiner's

comments about Forrester's density, the Examiner forgets that the rejection is to modify the epoxy foam of Forrester.

Claims 5 and 20 are allowable because neither of the references teaches the use of a polyimide foam having a density of at least 15 pounds per cubic foot. As for the Examiner's comments about Forrester's density, the Examiner forgets that the rejection is to modify the epoxy foam of Forrester.

Claims 6 and 21 are allowable because neither of the cited and applied references teaches the use of a polyimide foam having a density in the range of 12 to 25 pounds per cubic foot. As for the Examiner's comments about Forrester's density, the Examiner forgets that the rejection is to modify the epoxy foam of Forrester.

Claims 7 and 22 are allowable because neither of the cited and applied references teaches or suggests using a polyimide foam having a shear strength of 140 psi to 325 psi.

Claims 8 and 17 are allowable because neither of the cited and applied references teaches or suggests a seal substrate comprising a polymer composite. The casing (10) in Forrester et al. is formed from aluminum.

Claim 9 is allowable because neither of the cited and applied references teaches or suggests that the air seal is an outer seal.

Claim 10 is allowable because neither of the cited and applied references teaches or suggests that the air seal is a knife edge seal.

Claims 11 and 18 are allowable because neither of the cited and applied references teaches or suggests the use of a thermo-mechanically densified polyimide foam.

Claim 12 is allowable because neither of the cited and applied references teaches or suggests an abradable seal layer

applied to a bond layer, which abradable seal layer is composited of a densified polyimide foam.

Claim 13 is allowable because neither of the references teaches or suggests that the seal substrate comprises a stator box and the engine component comprises a disk.

Claim 14 is allowable because neither of the cited and applied references teaches or suggests using the claimed seal in connection with a seal substrate and a rotatable vane.

Claim 23 is allowable because neither of the cited and applied references teaches or suggests forming a bond layer from at least one adhesive strip.

Claim 24 is allowable because neither of the cited and applied references teaches or suggests forming a bond layer from a layer of adhesive material.

Claims 3 is allowable because none of the cited and applied references teaches or suggests an abradable seal layer comprising a plurality of layers of a densified polyimide foam.

Claim 15 is allowable because none of the cited and applied references teaches or suggests forming the abradable seal material from a plurality of layers of the densified polyimide foam having a lamination plane which is substantially perpendicular to the centerline.

New claim 45 is allowable because none of the cited and applied references teach or suggest an abradable seal layer consisting of a densified polyimide foam.

The instant application is believed to be allowable for the foregoing reasons. Such allowance is respectfully solicited.

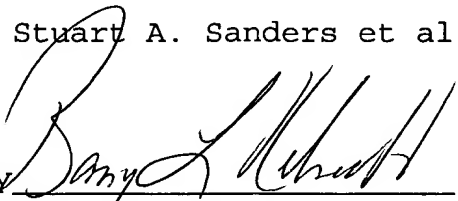
Should the Examiner believe an additional amendment is needed to place the case in condition for allowance, he is hereby invited to contact Applicant's attorney at the telephone number listed below.

Appl. No. 09/943,321  
Amdt. dated Sept. 29, 2004  
Reply to office action of June 29, 2004

The Commissioner is hereby authorized to charge the extra independent claim fee of \$86.00 to Deposit Account No. 21-0279. Should the Commissioner determine that an additional fee is due, he is hereby authorized to charge said fee to said Deposit Account.

Respectfully submitted,

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I, Nicole Motzer, hereby certify that this correspondence is being deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to: "Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313" on September 29, 2004.

